5. GEOTECHNICAL EVALUATION

5.0 GEOTECHNICAL EVALUATION

5.1 Introduction

As indicated previously the geotechnical evaluation for this phase of the project was limited to a literature review with very limited data on actual bottom conditions in the Acadiana Bays area. Lourie Consultants (LOURIE) provided these geotechnical engineering services to the project team. Sources of data included LDNR-provided reports from the general project area, information from other members of the project team, data in LOURIE's library, and telephone interviews with US Army Corps of Engineers (USACE) personnel with experience designing and constructing coastal structures. This chapter summarizes the geotechnical evaluation on this project. The full LOURIE report can be found in Appendix B.

5.2 Assumed Soil Conditions

Based on LOURIE's data review and experience, it is believed that very soft to soft, moderately to highly plastic compressible clay deposits are likely to be present in the project area. In what is believed to be a conservative assumption, LOURIE has assumed that these Holocene (Recent) clay deposits are present from the seafloor to about 40-ft penetration. Below 40 ft, it is assumed that older, stronger, and generally less compressible Pleistocene deposits are present.

For modeling purposes, LOURIE has assumed that the Recent clays are approximately normally consolidated with respect to current overburden pressures. Also, their undrained shear strengths tend to increase linearly with increasing depth. In the analytical models that were used, the soil was assumed to have an undrained shear strength of 0 psf at the seafloor that increases linearly to 400 psf at 40-ft penetration.

5.3 Analytical Activities

LOURIE's analytical efforts consisted of bearing capacity analysis to determine how much load could be applied to the seafloor soils by a structure. To allow the engineering team to consider a variety of materials and evaluate the cost-effectiveness of alternate designs, a series of plots were prepared that presented the results of the bearing capacity analyses. These plots allowed the engineering team to consider materials of

different weights, as well as structures built to various heights and widths. The bearing capacity analyses were supplemented by slope stability analyses.

The analyses showed that the thick, weak, clay soils could only support light loads without failing and even then, a rubble-mound structure would need to have a large base and very flat side slopes. Furthermore, the analyses showed large settlements could be expected. In summary, very soft and soft clays present many design, construction, and maintenance problems for a rubble-mound structure or any other any type of equivalent, constructed feature.

As an alternative to attempting to design and construct a structure on very soft and soft clays, LOURIE investigated the applicability of various soil improvement techniques that would be suitable for very soft to soft clays in a marine environment. It was determined that deep soil mixing methods (DSMMs) are one class of in-place soil improvement technology that appears promising. In general, the approach involves adding and mixing an admixture such cement, lime, flyash, etc., to the soil. The resulting and improved soil material generally has a higher strength and lower compressibility than the native soil.

It was concluded that DSMMs have the ability to improve the engineering properties of soils, including those of soft, compressible marine clays that are expected to be present in the project area. The limited review of published information about DSMMs indicated that significant increases in soil strength could be expected to occur following a DSMM program. Therefore, LOURIE was asked to assess the design of a traditional rubble-mound structure on DSMM-improved soil, i.e., one constructed using concrete rubble (or similar material) with a height of about 9 ft above the seafloor and side slopes of 1-vertical on 3-horizontal (1-V:3-H). LOURIE's bearing capacity and slope stability analyses revealed that the required soil strength was well within the range of improvement that DSMMs can be expected to achieve. LOURIE also concluded that DSMM-improved soils would be less compressible than unimproved soils, so it follows that long-term foundation-related maintenance for a structure constructed on DSMM-improved soil would be significantly less than the maintenance required for a structure over the unimproved foundation soils.

In summary, since DSMMs have the potential to improve the strength and reduce the compressibility of the existing soils, the design, construction, and maintenance of a rubble-mound (or equivalent) structure should be simplified and improved. This opinion applies not only in the Acadiana Bays project area, but it should also apply in other areas of coastal Louisiana.

5.4 Additional Considerations

Most of the above discussion has focused on design-related issues. Constructability and maintenance also are important and are influenced by geotechnical engineering properties of the foundation soils. LOURIE's report notes that construction operations in a marine environment involve equipment and methods that differ from those used for land-based construction. In addition, the construction of rubble-mound structure on the unimproved foundation soils is likely to present a number of challenges because of the expected low strength and compressibility of the foundation soils. During construction on very soft to soft clays, there is the potential for bearing capacity failures and/or large deformations to occur. As such, design and construction practices must consider these possibilities.

LOURIE believes the DSMM-improved soil option has the ability to address many of the concerns and solve many of potential problems associated with attempting to construct a structure on unimproved very soft and soft clay soils. Their report notes that construction-related failures should be reduced, there should be more flexibility in selecting materials to use for construction, there should be simpler and faster material placement, and there should be less maintenance required for the structure over its useful life.

All of the analyses that LOURIE conducted are based on assumed soil conditions and engineering properties. A detailed site- and project-specific geotechnical study is needed to refine the concepts discussed in their report and to produce a safe, cost-effective design.